GCSE
SCIENCE

Science Hub meeting

Booklet 3: Extracts from GCSE science specifications

Published: Spring 2020

Contents

Extract from GCSE Biology: Topic 1 – Cell biology

4.1.3 Transport in cells

4.1.3.1 Diffusion

Content	Key opportunities for skills development
Substances may move into and out of cells across the cell membranes via diffusion. Diffusion is the spreading out of the particles of any substance in solution, or particles of a gas, resulting in a net movement from an area of higher concentration to an area of lower concentration. Some of the substances transported in and out of cells by diffusion are oxygen and carbon dioxide in gas exchange, and of the waste product urea from cells into the blood plasma for excretion in the kidney. Students should be able to explain how different factors affect the rate of diffusion. Factors which affect the rate of diffusion are: • the difference in concentrations (concentration gradient) • the temperature • the surface area of the membrane. A single-celled organism has a relatively large surface area to volume ratio. This allows sufficient transport of molecules into and out of the cell to meet the needs of the organism.	WS 1.2 Recognise, draw and interpret diagrams that model diffusion. WS 1.5 Use of isotonic drinks and high energy drinks in sport.
Students should be able to calculate and compare surface area to volume ratios. Students should be able to explain the need for exchange surfaces and a transport system in multicellular organisms in terms of surface area to volume ratio. Students should be able to explain how the small intestine and lungs in mammals, gills in fish, and the roots and leaves in plants, are adapted for exchanging materials. In multicellular organisms, surfaces and organ systems are specialised for exchanging materials. This is to allow sufficient molecules to be transported into and out of cells for the organism's needs. The effectiveness of an exchange surface is increased by: • having a large surface area • a membrane that is thin, to provide a short diffusion path • (in animals) having an efficient blood supply • (in animals, for gaseous exchange) being ventilated.	MS 1c, 5c

4.1.3.2 Osmosis

Content	Key opportunities for skills development
Water may move across cell membranes via osmosis. Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane.	WS 1.2 Recognise, draw and interpret diagrams that model osmosis.
Students should be able to: • use simple compound measures of rate of water uptake • use percentages • calculate percentage gain and loss of mass of plant tissue.	MS 1a, 1c
Students should be able to plot, draw and interpret appropriate graphs.	MS 4a, 4b, 4c, 4d

Required practical activity 3: investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue.

AT skills covered by this practical activity: AT 1, 3 and 5.

This practical activity also provides opportunities to develop WS and MS. Details of all skills are given in Key opportunities for skills development.

4.1.3.3 Active transport

Content	Key opportunities for skills development
Active transport moves substances from a more dilute solution to a more concentrated solution (against a concentration gradient). This requires energy from respiration. Active transport allows mineral ions to be absorbed into plant root hairs from very dilute solutions in the soil. Plants require ions for healthy growth. It also allows sugar molecules to be absorbed from lower concentrations in the gut into the blood which has a higher sugar concentration. Sugar molecules are used for cell respiration. Students should be able to: • describe how substances are transported into and out of cells by diffusion, osmosis and active transport • explain the differences between the three processes.	There are links with this content to Cell specialisation.

Extract from GCSE Chemistry: Topic 4 – Chemical changes

4.4.2 Reactions of acids

4.4.2.1 Reactions of acids with metals

Content	Key opportunities for skills development
Acids react with some metals to produce salts and hydrogen. (HT only) Students should be able to: • explain in terms of gain or loss of electrons, that these are redox reactions • identify which species are oxidised and which are reduced in given chemical equations. Knowledge of reactions limited to those of magnesium, zinc and iron with hydrochloric and sulfuric acids.	

4.4.2.2 Neutralisation of acids and salt production

Content	Key opportunities for skills development
Acids are neutralised by alkalis (eg soluble metal hydroxides) and bases (eg insoluble metal hydroxides and metal oxides) to produce salts and water, and by metal carbonates to produce salts, water and carbon dioxide. The particular salt produced in any reaction between an acid and a base or alkali depends on: • the acid used (hydrochloric acid produces chlorides, nitric acid produces nitrates, sulfuric acid produces sulfates) • the positive ions in the base, alkali or carbonate. Students should be able to: • predict products from given reactants • use the formulae of common ions to deduce the formulae of salts.	

4.4.2.3 Soluble salts

Content	Key opportunities for skills development
Soluble salts can be made from acids by reacting them with solid insoluble substances, such as metals, metal oxides, hydroxides or carbonates. The solid is added to the acid until no more reacts and the excess solid is filtered off to produce a solution of the salt. Salt solutions can be crystallised to produce solid salts. Students should be able to describe how to make pure, dry samples of named soluble salts from information provided.	

Required practical 1: preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution.

AT skills covered by this practical activity: 2, 3, 4 and 6.

This practical activity also provides opportunities to develop WS and MS. Details of all skills are given in Key opportunities for skills development (page 103).

4.4.2.4 The pH scale and neutralisation

Content	Key opportunities for skills development
Acids produce hydrogen ions (H^+) in aqueous solutions. Aqueous solutions of alkalis contain hydroxide ions (OH^-). The pH scale, from 0 to 14, is a measure of the acidity or alkalinity of a solution, and can be measured using universal indicator or a pH probe. A solution with pH 7 is neutral. Aqueous solutions of acids have pH values of less than 7 and aqueous solutions of alkalis have pH values greater than 7. In neutralisation reactions between an acid and an alkali, hydrogen ions react with hydroxide ions to produce water. This reaction can be represented by the equation: $H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$ Students should be able to: • describe the use of universal indicator or a wide range indicator to measure the approximate pH of a solution • use the pH scale to identify acidic or alkaline solutions.	AT 3 This is an opportunity to investigate pH changes when a strong acid neutralises a strong alkali.

4.4.2.5 Titrations (chemistry only)

Content	Key opportunities for skills development
The volumes of acid and alkali solutions that react with each other can be measured by titration using a suitable indicator. Students should be able to: • describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids only) to find the reacting volumes accurately • (HT Only) calculate the chemical quantities in titrations involving concentrations in mol/dm^3 and in g/dm^3.	

Required practical 2: (chemistry only) determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration.

(HT only) determination of the concentration of one of the solutions in mol/dm^3 and g/dm^3 from the reacting volumes and the known concentration of the other solution.

AT skills covered by this practical activity: 1 and 8.

This practical activity also provides opportunities to develop WS and MS. Details of all skills are given in Key opportunities and skills development (page 104).

4.4.2.6 Strong and weak acids (HT only)

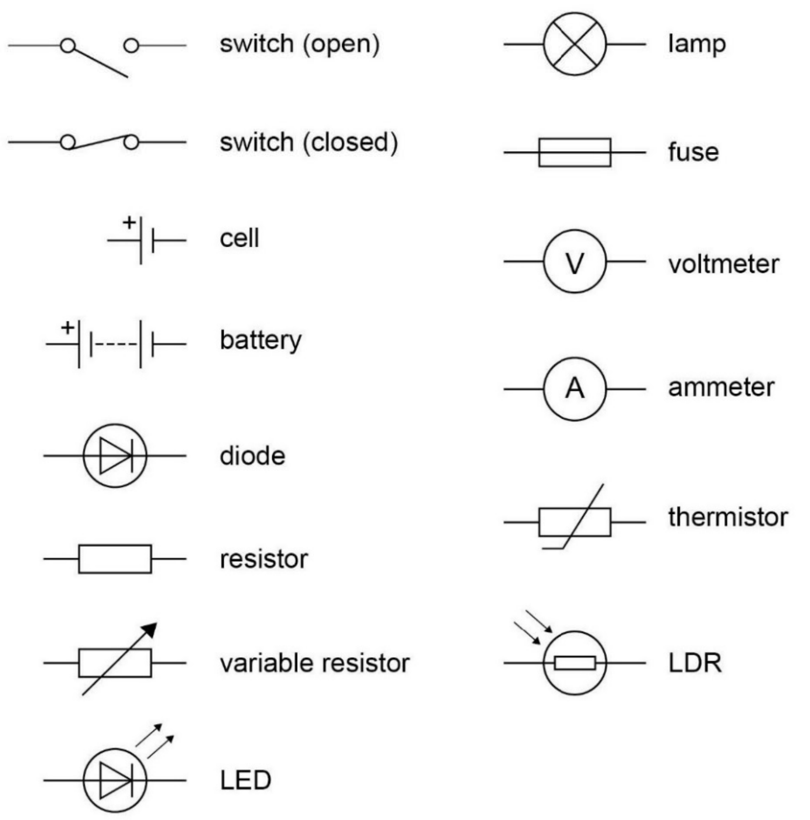
Content	Key opportunities for skills development
A strong acid is completely ionised in aqueous solution. Examples of strong acids are hydrochloric, nitric and sulfuric acids. A weak acid is only partially ionised in aqueous solution. Examples of weak acids are ethanoic, citric and carbonic acids. For a given concentration of aqueous solutions, the stronger an acid, the lower the pH. As the pH decreases by one unit, the hydrogen ion concentration of the solution increases by a factor of 10. Students should be able to: • use and explain the terms dilute and concentrated (in terms of amount of substance), and weak and strong (in terms of the degree of ionisation) in relation to acids	AT 8 An opportunity to measure the pH of different acids at different concentrations.
• describe neutrality and relative acidity in terms of the effect on hydrogen ion concentration and the numerical value of pH (whole numbers only).	MS 2h Make order of magnitude calculations.

Extract from GCSE Physics: Topic 2 – Electricity

4.2.1 Current, potential difference and resistance

4.2.1.1 Standard circuit diagram symbols

Content	Key opportunities for skills development
Circuit diagrams use standard symbols.	WS 1.2



Content	Key opportunities for skills development
Students should be able to draw and interpret circuit diagrams.	

4.2.1.2 Electrical charge and current

Content	Key opportunities for skills development
For electrical charge to flow through a closed circuit the circuit must include a source of potential difference.	

Content	Key opportunities for skills development
Electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge. Charge flow, current and time are linked by the equation: $charge\ flow = current \times time$ $[\ Q = I\ t\ ]$ charge flow, *Q*, in coulombs, C current, *I*, in amperes, A (amp is acceptable for ampere) time, *t*, in seconds, s A current has the same value at any point in a single closed loop.	MS 3b, c Students should be able to recall and apply this equation.

4.2.1.3 Current, resistance and potential difference

Content	Key opportunities for skills development
The current (*I*) through a component depends on both the resistance (*R*) of the component and the potential difference (*V*) across the component. The greater the resistance of the component the smaller the current for a given potential difference (pd) across the component. Questions will be set using the term potential difference. Students will gain credit for the correct use of either potential difference or voltage.	
Current, potential difference or resistance can be calculated using the equation: $potential\ difference = current \times resistance$ $[\ V = I\ R\ ]$ potential difference, *V*, in volts, V current, *I*, in amperes, A (amp is acceptable for ampere) resistance, *R*, in ohms, Ω	MS 3b, c Students should be able to recall and apply this equation.

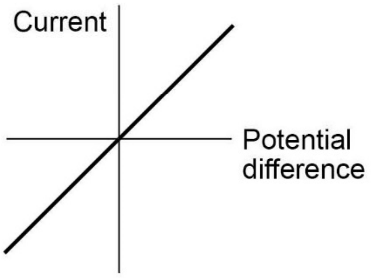
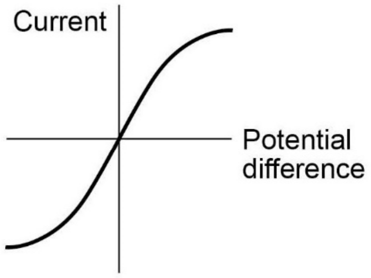
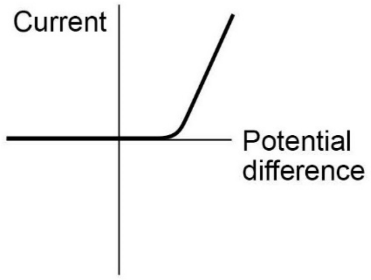
Required practical activity 3: Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include:

- the length of a wire at constant temperature
- combinations of resistors in series and parallel.

AT skills covered by this practical activity: AT 1, 6 and 7.

This practical activity also provides opportunities to develop WS and MS. Details of all skills are given in Key opportunities for skills development (page 91).

4.2.1.4 Resistors

Content	Key opportunities for skills development
Students should be able to explain that, for some resistors, the value of *R* remains constant but that in others it can change as the current changes. The current through an ohmic conductor (at a constant temperature) is directly proportional to the potential difference across the resistor. This means that the resistance remains constant as the current changes.  The resistance of components such as lamps, diodes, thermistors and LDRs is not constant; it changes with the current through the component. The resistance of a filament lamp increases as the temperature of the filament increases.  The current through a diode flows in one direction only. The diode has a very high resistance in the reverse direction.  	

Content	Key opportunities for skills development
The resistance of a thermistor decreases as the temperature increases. The applications of thermistors in circuits eg a thermostat is required. The resistance of an LDR decreases as light intensity increases.	
The application of LDRs in circuits eg switching lights on when it gets dark is required. Students should be able to:	WS 1.2, 1.4
• explain the design and use of a circuit to measure the resistance of a component by measuring the current through, and potential difference across, the component • draw an appropriate circuit diagram using correct circuit symbols.	AT 6 Investigate the relationship between the resistance of a thermistor and temperature. Investigate the relationship between the resistance of an LDR and light intensity.
Students should be able to use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties.	WS 1.2, 1.4 MS 4c, d, e

Required practical activity 4: use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements, including a filament lamp, a diode and a resistor at constant temperature.

AT skills covered by this practical activity: AT 6 and 7.

This practical activity also provides opportunities to develop WS and MS. Details of all skills are given in Key opportunities for skills development (page 93).

Contact us

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

Tel: 01483 477 756
Email: gcsescience@aqa.org.uk
Twitter: @AQA

aqa.org.uk